Title: Method for providing textures on products

The invention relates to a method for providing texture on a product part. Such a method is known from practice.

To obtain, for instance, a pleasant appearance or a suitable roughness of the surface of a product, there are used methods for providing texture thereon, which comprise providing patterns in relief on the relevant product, at least product part. To this end, patterns of depressions or differently shaped deformations of the surface of the relevant product part are provided, for instance, by means of mechanical or optical means. These deformations afford a texture. The deformations may be provided directly on a part of a consumer article but may, for instance, also be made in a die, such that when forming products in the relevant die, the desired structure is transferred to parts of products formed in the die.

In the known method, regular or irregular patterns of depressions are provided in one operating cycle. There is thus obtained a texture having at least one clear direction of orientation, which is often undesirable, since this results in a texture having a less pleasant appearance. Proposals have already been made to provide the deformations randomly, so as to prevent directions of orientation from remaining visible in the texture. This, true, ensures a more pleasant appearance of the relevant product part, but repair of the relevant texture is no longer possible, in view of the random distribution. This means that in particular when texture is provided in a die, repair of the die when, for instance, it has become worn or otherwise damaged, is substantially impeded, if not made impossible.

The object of the invention is to provide a method of the type described in the introduction, in which the above drawbacks are avoided, while retaining the advantages thereof. To this end, a method according to the present invention is characterized by the measures according to claim 1.

By using grids of rows and columns of deformations, in which at least two grids are provided in a displaced position with respect to each other, there is obtained the advantage that the undesirable directions of orientation can be prevented from remaining visible. The term displaced as used herein should be understood as at least comprising linear displacements and in particular rotations, as well as combinations thereof.

The density of the deformations and the positions of the rows and/or columns of the relevant grids, at least of the deformations therein, can be displaced with respect to each other such that an at least visually slightly random distribution of the deformations is obtained. Moreover, interference patterns can thus be prevented or, on the other hand, be stressed. In this connection, it is preferable that the deformations of a first grid are at least partly overlapped by deformations of the second grid, which has the result that the random impression of the texture is further increased. By using grids having a regular known distribution of the deformations, there is obtained the advantage that in a very simple manner repair of the relevant grids and hence of the texture is possible. In fact, this only requires that the position of the relevant grid is again equally adjusted. This has the result that the service life of, for instance, dies can be substantially increased, that the reproducibility of the product parts, at least the texture thereon, can be substantially improved, and that, moreover, there is obtained a very great freedom of generating texture, starting from very simple patterns.

When forming deformations and depressions, material can also be removed, if required.

In a further elaboration, a method according to the present invention is further characterized by the measures according to claim 3.

Surprisingly, it has been found that exactly rotation of at least one of the grids with respect to at least one of the other grids leads to texture having a very pleasant appearance. Viewed from the center of rotation, the distances between deformations of a first grid and deformations in a second grid rotated with respect thereto will change in relation to the distance from the relevant deformations to the above center of rotation, which, moreover, results in different degrees of overlap of deformations. This will still further increase the random appearance of the texture, while the reproducibility remains the same.

In a very advantageous embodiment, a method according to the present invention is further characterized by the measures according to claim 5.

It has been found that when five, preferably equal grids are used, which are always rotated with respect to each other through an angle of 36° or a multiple thereof, a very advantageous texture is obtained. This texture has a very pleasant appearance, in particular because no direction of

orientation is visible therein anymore and interference patterns are maximally prevented, while such a texture is excellently reproducible.

In a method according to the present invention, a laser is preferably used to provide the deformations, which deformations are preferably point-shaped. It will be clear, however, that other methods may also be suitable for providing deformations, for instance mechanical operations, in which the deformations may additionally be differently shaped, for instance line-shaped.

In a further elaboration, a method according to the present invention is characterized by the measures according to claim 9.

By carrying out the deformations as a central depression with an edge raised from the surface positioned around it, there is obtained a texture of the type described above, in which, moreover, the roughness of the surface is slightly increased. Besides, this can further improve the random appearance of the texture. Such deformations can be simply obtained, for instance, by using a suitable laser. The selection and adjustment of such a laser will be immediately clear to those skilled in the art.

In a preferred embodiment, a method according to the present invention is further characterized by the measures according to claim 10.

Exactly by providing a texture according to the present invention on a forming tool, such as a die, a punch, a vacuum mold or the like, there is obtained the advantage that the resulting texture can be transferred to a large number of products in a very simple manner. As a result of the selected texture, maintenance and repair of the relevant forming tool is possible in a simple manner.

The invention further relates to a product provided with a texture, characterized by the measures according to claim 13.

The invention further relates the use of a laser for providing texture on a product part, characterized by the measures according to claim 16.

The invention also relates to the use of a method for repairing texture, characterized by the measures according to claim 17.

Further advantageous embodiments of a method, product and use according to the invention are given in the subclaims. In explanation, exemplary embodiments of a method, apparatus and use according to the

invention will be explained in more detail, with reference to the drawings, in which:

Fig. 1 diagrammatically shows a texture built up from two superimposed grids rotated with respect to each other;

Fig. 2 diagrammatically shows five grids rotated with respect to each other;

Figs. 3A-H show a number of examples of textures formed according to the invention, on a very large scale; and

Fig. 4 shows a depression in cross-section.

In Figs. 1 and 2, there are used respectively two and five different symbols for indicating the different grids rotated with respect to each other. In practice, these grids will be built up from mutually equal, at least identically shaped, deformations of the same kind.

Fig. 1 diagrammatically shows, on an enlarged scale, a surface 1 of a product, in top plan view, on which two grids 2, 4 are provided, which will be explained below in more detail. The product 1 is, for instance, a die cavity, in which products, such as consumer articles, chips, chips bars or the like can be produced, for instance by molding. During the formation of the above article in the die cavity, the texture 10, 110 formed by the grids 2, 4 will be transferred to a corresponding part of the product to be formed.

In the embodiment shown in Fig. 1, a first grid 2 is built up from rows R2 and columns K2, deformations of the surface 1, in particular depressions 6 in the surface 1, as, for instance, shown in Fig. 4 in cross-section. The depressions 6 in the first grid 2 are represented by squares. The depressions 6 are provided by means of a suitable laser and form the grid 2 in the form of a regular matrix. The depressions 6 have, in particular, a crater shape with a substantially circular cross-section in top plan view. By making a suitable selection of the type of laser and the adjustment thereof, in particular the power used and optionally used protective gases, and the duration of the exposure, the shape of the depression 6 and the edge 8 optionally raised around it, can be adjusted in a simply reproducible manner. In particular the use of lasers for providing the grids 2, 4 offers the advantage of high accuracy and reproducibility. It will be clear, however, that optionally other deformation techniques, too, can be used in a comparable manner, such as milling, punching, pressing, water cutting and the like. The second grid 4, represented in Fig. 1 by triangles, also

comprises, in a matrix comparable to that of the first grid 2, rows R4 and columns K4 of depressions 6, which are mainly equal to the depressions 6 in the first grid 2. The second grid 4 is rotated with respect to the first grid 2 through an angle α, in the embodiment shown, for instance, approximately 45°. As a result thereof, the depressions 6 of the first grid 2 will be at least partly covered by the depressions 6 of the second grid 4. In the ready texture 10, formed by the grids 2, 4, this results in composite, irregularly formed depressions, which afford the texture 10 a semi-random appearance, mainly without interference patterns, while the texture 10 is simply reproducible. In fact, the regular grids 2, 4 can be simply repaired or reproduced, while the angle α enclosed between the grids 2, 4 is unambiguously determined, as is the center of rotation C. When the die has become worn, the texture 10 can therefore be simply repaired, as a result of which products having a constant quality can permanently be manufactured in the relevant die.

Fig. 2 shows a texture 10, built up from five grids, comparable to those shown in Fig. 1. In this embodiment, a first grid 102 is represented in Fig. 2 by a matrix of squares. A second grid 104, represented by circles, a third grid 112, represented by octagons, a fourth grid 114, represented by triangles, and a fifth grid 116, represented by hexagons, are placed over it. Each of the grids 102, 104, 112, 114, 116 is built up from rows R and columns K of depressions 106, the depressions of all grids being the same. Only for the purpose of explanation, they are shown in the figure as differently shaped. Incidentally, it is observed that the depressions 6 of different grids may also be of a different kind, for further adaptation of the texture 10, 110. The second grid 104 is rotated around a point C with respect to the first grid 102 through an angle α_2. This means that the rows R and the columns K of the second grid 104 enclose an angle α_2 with respectively the rows R and columns K of the first grid 102. In a comparable manner, the third grid 112, the fourth grid 114, and the fifth grid 116 are rotated with respect to the first grid 102 around the point C through respectively a third angle α_3, a fourth angle α_4, and a fifth angle α_5. The first grid 102 defines a base angle α_1, represented in Fig. 2 by a horizontal line, which means that the angle α_1 is set at 0°. In the example shown in Fig. 2, there is selected a very favorable distribution of the angles, i.e. α_2 is 36°, α_3 is 72°, α_4 is 108°, and α_5 is 144°, starting from α_1 is 0°. There is thus

obtained a texture 110, built up from regular grids, which texture has a random appearance and is yet properly reproducible. In fact, for each of the grids only one starting position needs to be fixed.

It will be clear that by using more or fewer grids and/or by using other enclosed angles, other distributions of the depressions 6, 106 and hence other textures are obtained. Precisely in the embodiment shown in Fig. 2, it has been found, surprisingly, that none, at least minimal interference patterns occur, which makes such a texture excellently useful. As already observed, by means of a suitable selection of the deformation technique, in particular the selection of specific laser techniques, the energy to be introduced, the starting material and, optionally, the use of protective gases, the shape of each depression 6, 106 can be optimized. Thus, for instance, such deformation can be effected that none or only a minimal raised edge 8 is obtained, which results in a relatively smooth texture. In particular the use of a protective gas can influence the flow pattern positively. Also, material may be removed, for instance by combustion, sublimation and the like.

In the exemplary embodiments shown in Figs. 1 and 2, there is rotation of the different grids around a central point C. It will be clear, however, that rotations of a different kind and combined rotation-translation movements are also possible to obtain comparable (semi-) random textures, which are properly reproducible.

Figs. 3A-H show a number of examples of textures manufactured on a steel surface suitable for injection molding of plastic. For this an Nd:YAG laser is used, while applying argon as protective gas. Table 1 gives a number of setting values for each of the examples shown. As appears from Table 1, the examples as shown in Figs. 3A-F have been carried out according to Fig. 2, the example as shown in Fig. 3G has been carried out as shown in Fig. 1, with an angle α of 90° and with a distance between the columns which is regular but deviates from the regular distance between the rows. The exemplary embodiment as shown in Fig. 3G is made with four grids rotated with respect to each other at regular angles.

sample no.	pulse duration ms	RMS value mv	pulse freq. Hz	spot size micro-meter	spacing micro-meter	laser configuration cavity mm	voltage	focus mm above surface	degrees per step
1 (3A)	0.075	43	300	20	50	2.4	100%	6	Random m.
2 (3B)	0.25	84	100	110	300	2.4	100%	3	Random m.
3 (3C)	0.25	84	100	125	400	2.4	100%	2.5	Random m.
4 (3D)	0.25	84	100	160	300	2.4	100%	1	Random m.
5 (3E)	0.075	46	300	65	180	2.4	100%	0	Random m.
6 (3F)	0.075	46	300	80	230	2.4	100%	2	Random m.
7 (3G)	0.075	46	300	80	Sp. 500/507	2.4	100%	2	Degr.0&90
8 (3H)	0.075	46	300	65	230	2.4	100%	0	Degr.0,2,4,6

The exemplary embodiments shown in the drawings should by no means be regarded as limitative. Thus, other lasers may be used, in particular pulsating lasers, while, moreover, other protective gases may be used, for instance helium CO_2, N_2, Ar, and mixtures thereof. By means of the protective gases the material is protected from oxidation, and the flow behavior of the molten material is influenced. Moreover, influencing of the plasma thereby occurs. As a result thereof, the amount of energy supplied to the material is influenced, as is the temperature which the material can reach under the influence of the laser.

A texture according to the present invention is particularly suitable for being provided in a molding die or on, for instance, a punching or pressing tool, but can also be provided directly on a consumer article. The depressions of the different grids may advantageously all be identical, but it is also possible to provide different depressions for the different grids, to further influence the texture. Although, in the exemplary embodiments shown, the texture is provided circularly, it will be clear that any regular or irregular contour may be obtained for the texture, while such a texture may be provided both on flat and on single- or double-curved surfaces. These and many comparable variations are deemed to fall within the scope of the invention defined by the claims.